Active Project (2016 - 2016)

An Advanced Anode Electrocatalysis Concept for Direct Methane SOFC Systems, Phase I Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)

ABSTRACT

Planned Mars missions require long duration stays in orbit or at planet's surface, cannot rely on availability of pure reactant for power generation, and necessitate sun-independent operation capability. Direct methane solid oxide fuel cell (DM-SOFC) technology with an internal reforming approach has been investigated for generation of electric power from methane in order to preserve mission flexibility. Current internal reformer catalyst uses a significant amount of water (or oxygen) in the fuel stream to eliminate carbon coking issue. Lynntech proposes an advanced anode catalysis concept for DM-SOFC that is free of carbon coking without the use of water (or oxygen) in the fuel stream. Preliminary results with Lynntech's advanced anode catalysis concept using 100% dry hydrocarbon fuels demonstrated similar power densities to direct internal reforming technology. In Phase I, Lynntech will further optimize the anode electrocatalyst component and architecture, demonstrate the performance improvements and durability with single cells running on dry methane, and built and operate a bipolar short stack. In Phase II, Lynntech will built a bipolar 3-kW DM-SOFC stack and integrate all of the balance of plant component, demonstrate its performance and durability with improved thermal cycling (using dry methane), and deliver it to NASA for further testing.

ANTICIPATED BENEFITS

To NASA funded missions:

Potential NASA Commercial Applications: Future space missions will require a significant degree of mission flexibility (meaning utilize the resources available at the destination). Power generation devices are one of the critical components that determine the mission flexibility parameter. Solid oxide fuel cell based generation of electric power maximizes the mission flexibility and such systems can be used for the following potential NASA commercial applications: Mars landers, rovers,

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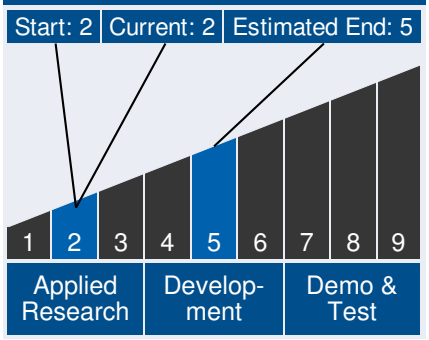
Technology Maturity



Management Team

Program Executives:

- Joseph Grant
- Laguduva Kubendran

Program Manager:

- Carlos Torrez

Continued on following page.

and other exploration vehicles, sun-independent electrical power generation for crew transportation systems and surface systems, power generation for surface mobility systems, Lunar landers, and other similar applications.

To the commercial space industry:

Potential Non-NASA Commercial Applications: Solid oxide fuel cell systems (with reformer integrated option) demonstrated the highest achievable energy efficiency for electric power generation from hydrocarbon fuels such as natural gas, methane, syngas, and other similar fuels. Carbon coking issue has been very detrimental on the long term durability (which has also affected their commercialization) and a major hurdle to overcome without the use of additional water or oxygen in the fuel stream. Lynntech's advanced anode catalysis concept already demonstrated carbon coking free operation without the use of additional water (or oxygen). Potential non-NASA commercial applications for this technology would be: commercial and military unmanned underwater vehicles, military tactical gen-sets, auxiliary power units for silent-watch vehicles, commercial and military unmanned aerial vehicles, and residential micro-combined heat and power systems.

Management Team *(cont.)*

Principal Investigator:

- Mahesh Waje

Technology Areas

Primary Technology Area:
Space Power and Energy Storage (TA 3)
└ Power Generation (TA 3.1)
  └ Chemical (TA 3.1.2)

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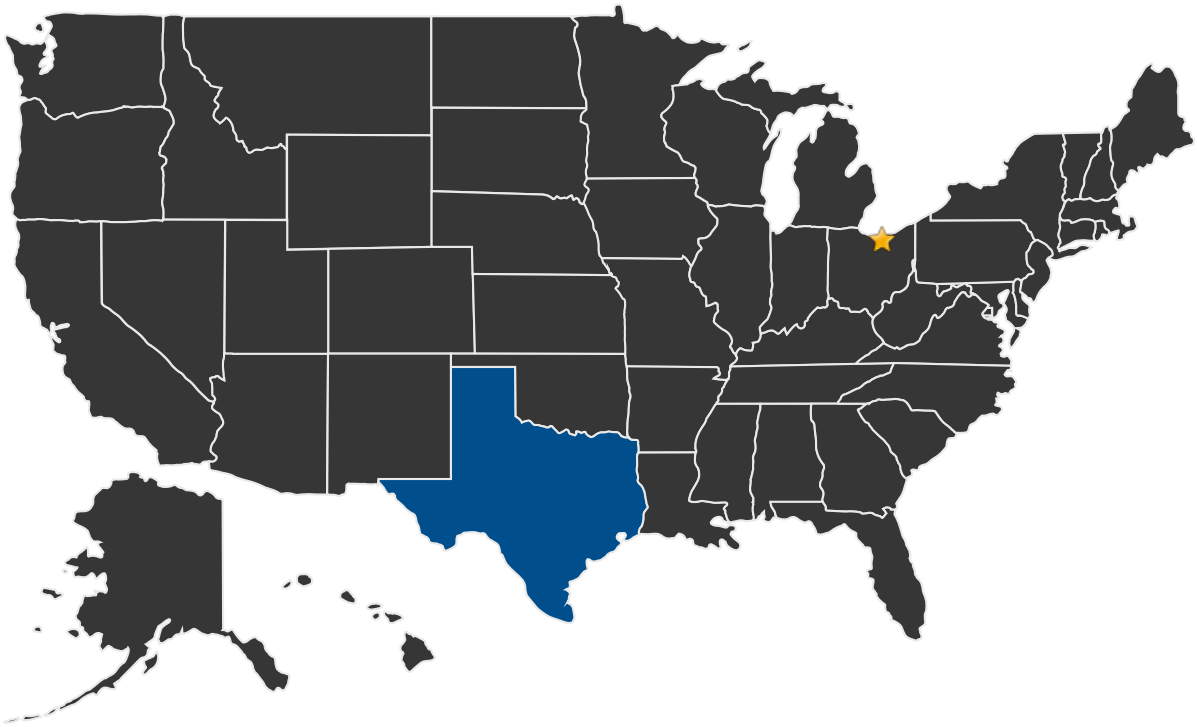
U.S. WORK LOCATIONS AND KEY PARTNERS



U.S. States With Work

Lead Center:
Glenn Research Center

Other Organizations Performing Work:

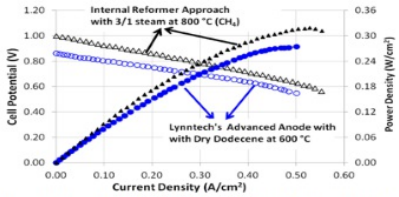
- Lynntech, Inc. (College Station, TX)

PROJECT LIBRARY

Presentations

- Briefing Chart
  - (http://techport.nasa.gov:80/file/23385)

IMAGE GALLERY



Lynntech's advanced anode electrocatalysis concept performance comparison to internal reformer approach.

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DETAILS FOR TECHNOLOGY 1

Technology Title

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Potential Applications

Future space missions will require a significant degree of mission flexibility (meaning utilize the resources available at the destination). Power generation devices are one of the critical components that determine the mission flexibility parameter. Solid oxide fuel cell based generation of electric power maximizes the mission flexibility and such systems can be used for the following potential NASA commercial applications: Mars landers, rovers, and other exploration vehicles, sun-independent electrical power generation for crew transportation systems and surface systems, power generation for surface mobility systems, Lunar landers, and other similar applications.